Physical Review D - Particles, Fields, Gravitation and Cosmology 2013 vol.88 N4

Structure of neutron, quark, and exotic stars in Eddington-inspired Born-Infeld gravity

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Abstract

We consider the structure and physical properties of specific classes of neutron, quark, and "exotic" stars in Eddington-inspired Born-Infeld (EiBI) gravity. The latter reduces to standard general relativity in vacuum, but presents a different behavior of the gravitational field in the presence of matter. The equilibrium equations for a spherically symmetric configuration (mass continuity and Tolman-Oppenheimer-Volkoff) are derived, and their solutions are obtained numerically for different equations of state of neutron and quark matter. More specifically, stellar models, described by the stiff fluid, radiationlike, polytropic and the bag model quark equations of state are explicitly constructed in both general relativity and EiBI gravity, thus allowing a comparison between the predictions of these two gravitational models. As a general result it turns out that for all the considered equations of state, EiBI gravity stars are more massive than their general relativistic counterparts. Furthermore, an exact solution of the spherically symmetric field equations in EiBI gravity, describing an exotic star, with decreasing pressure but increasing energy density, is also obtained. As a possible astrophysical application of the obtained results we suggest that stellar mass black holes, with masses in the range of 3.8M and 6M, respectively, could be in fact EiBI neutron or quark stars.

http://dx.doi.org/10.1103/PhysRevD.88.044032